Pakistan Economic Analysis Network Project

BENEFITS TO O&M EXPENDITURE IN THE CANAL SYSTEM IN PUNJAB

Policy Options Briefing Paper Series
No. 2

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PREFACE

This policy briefing paper has been prepared by the Economic Analysis Network (EAN) Project to demonstrate to a broader audience of agricultural policy formulators, analysts, and other interested agricultural specialists the practical agricultural policy implications of technical economic studies undertaken by the EAN on this subject. The paper forms part of a series of policy briefing papers being prepared by the EAN Project to strengthen the economic capabilities of the newly formed Economic Wing, Ministry of Food, Agriculture, and Cooperatives. The Economic Wing has been organized to replace the Planning Unit. More information on the Economic Wing's agricultural policy research programs can be obtained by contacting:

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1. IRRIGATION SYSTEM: AN OVERVIEW

A significant feature of Pakistan's irrigated agriculture is the Indus irrigation system, which is the largest contiguous irrigation system in the world. The system encompasses the Indus River and its tributaries, three major storage reservoirs, 19 barrages/headworks, 12 link canals, and 43 canal commands covering about 43 chaks. The total length of the canal system is about 40,000 miles with watercourses, field channels and field ditches running for another million miles. Approximately, 100 million acre feet (MAF) of surface irrigation supplies are diverted annually into this canal system. However, only 60 percent of this water reaches the farmgate. Public tubewells installed under the Salinity Control & Reclamation Project (SCARP) constitute another important component of the public irrigation system. There are about 14,000 public tubewells which annually supply 10.1 MAF of water at the farmgate.

2. THE PROBLEM OF OPERATION & MAINTENANCE (O&M)

O&M includes the management of water supplies and the upkeep of system facilities, from the water source to the farmer's fields. Therefore, once an irrigation system is working, its O&M play a critical role in determining the growth of the agricultural sector. Inadequate maintenance of the canals results in frequent breaches and consequent interruptions in water supplies. In turn, this may:

* lower the cultivated area
* depress crop yields
* result in a shift to low value crops
* reduce on-farm investments
* lower investment in yield enhancing variable inputs

Pakistan's canal system is deteriorating rapidly because of continuously deferred maintenance. The ability to carry out maintenance is inhibited, to a major degree, by financial constraints. Financial constraints appear to be more binding because the revenue generated by the system have not kept pace with rising O&M costs; the latter have increased due to the positive relationship between the system's deterioration rate and the age of the system.

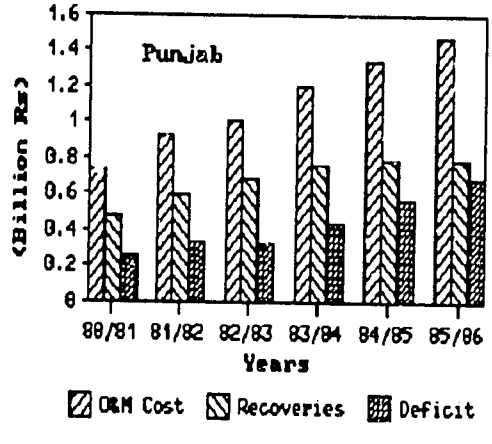
3. CURRENT O&M BUDGET ALLOCATION PATTERN

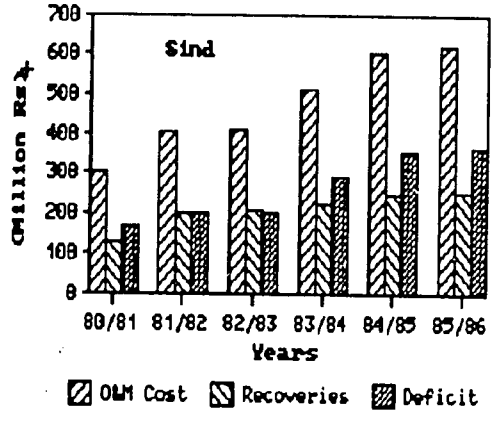
O&M of the canal system and public tubewells is the responsibility of provincial irrigation departments (PIDs). The provincial finance departments provide funds to the PIDs for O&M activities through the non-development budgets (NDB). The PIDs prepare the annual O&M budget by applying a "yardstick model" to the existing inventory of irrigation facilities. Financial allocations made for O&M of canals and tubewells in two leading provinces of Pakistan are shown in Table 1. Two conclusions are quite clear from the Table. First, although the total O&M budget is increasing, the share of canals is

Table 1: O&M Expenditure[1] and Recoveries From Water Charges in Punjab and Sind Provinces (Figures in Million Rupees).

Province/System	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
Punjab						
Surface System	312.10	461.90	494.30	567.10	666.60	680.00
SCARP Tubewells	425.30	469.60	513.00	628.20	680.70	790.00
Total O&M Cost	737.40	931.50	1007.30	1195.30	1347.30	1470.00
Recoveries	473.00	593.10	688.11	760.00	782.80	792.32
Deficit	264.40	338.40	319.19	435.30	564.50	677.68
Sind						
Surface System	230.17	317.65	304.50	384.17	435.37	460.56
SCARP Tubewells	72.79	87.88	108.90	131.49	168.25	163.15
Total O&M Cost	302.96	405.53	413.40	515.66	603.62	623.71
Recoveries	131.50	203.00	210.00	224.10	246.50	254.18
Deficit	171.46	202.53	203.40	291.56	357.12	369.53

[1] Establishment costs of surface system and SCARP tubewells are included in their respective total costs. Costs of surface system includes canals, flood control, small dams and other minor items as well.





relatively decreasing. Second, the gap between O&M expenditure and revenues collected as water charges has been increasing consistently.

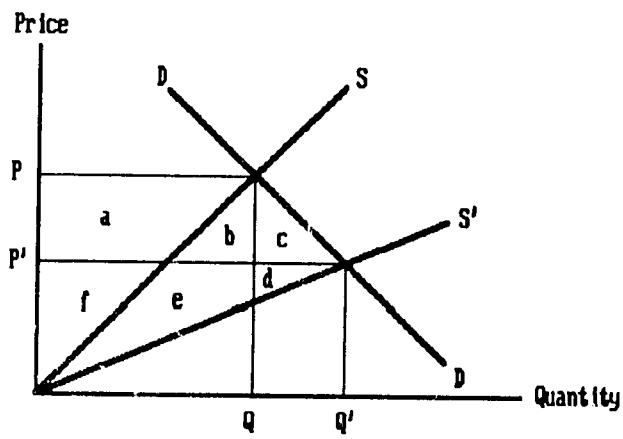
Many experts are of the opinion that both the past and existing budgetary allocations for O&M of canals have been far below what is actually required to maintain the system efficiently. Consequently, the canal system deteriorated to the extent that the GOP and donor agencies are now providing US $ 118 million for its rehabilitation. An important question which arises here is: how much should be spent on O&M of the canal system? Advocates of the technical efficiency criterion would argue for an amount that may turn the system into an "ideal condition"--a system having no losses, no siltation, no breaches etc. On the other hand, the economic efficiency criterion requires that allocations for O&M spending should be based on the marginal cost/benefit principle.

Historically, there have been a number of attempts to determine the technically desired O&M spending levels, often referred to as "full funding" levels. However, these levels do not seem to be either consistent with each other or simultaneously acceptable to PID engineers, finance departments, and to major external donor agencies. Moreover, the magnitude of funds required under the technical efficiency criterion can be met only if funds are available in an unlimited amount. In practice, however, this is not the case. Financial resources tend to be scarce and thus claim to have a very high opportunity cost. This underscores the need to use economic efficiency criterion to make budgetary allocation decisions.

5. FRAMEWORK FOR MEASURING BENEFITS TO O&M

Many components of the irrigation system such as SCARP tubewells, small dams, and drainage facilities actively compete with the canals to have a larger share in the total irrigation O&M budget. Since O&M of the canal irrigation system is an expensive activity, it is important to ascertain its social productivity. This issue was explored in a recent study carried out under the auspices of the EAN Project. The study developed an econometric model to capture the relationship between O&M spending and agricultural productivity. It is important to note that a long tradition of experts has been to deal with O&M spending in largely conceptual terms, usually concluding that higher investments in O&M activities would improve agricultural productivity. The EAN study, to our knowledge, is the first effort to formulate an analytical model to establish this relationship.

Before discussing the results of the EAN study, it is important to conceptualize how O&M would increase agricultural productivity. Assume a situation where demand and supply of agricultural output is in equilibrium at output Q and price P. Higher O&M spending would reduce the possibility of frequent canal breaches and improve the delivery efficiency of the system. This would result in larger and more timely availability of irrigation water. Consequently, agricultural production would increase through increases in both irrigated area and per acre yield. The supply curve would shift from S to S' in above figure, changing equilibrium prices from P to P' and output from Q to Q'. Consumers would definitely gain because of decline in prices, while producers may gain (or lose) depending upon whether the output or price impact is stronger. Net social benefits are summarized below:



Gain to consumers	=	a + b + c
Loss to producers	=	a - (d + e)
Loss to taxpayers	=	O&M expenditure
Net gains to society	=	b + c + d + e - (O&M expenditure)

6. RESULTS

* Benefits from O&M spending on canal system are distributed over time.

* A 10 percent increase in O&M expenditures on canals in one year would increase agricultural productivity by 30 percent in six years.

* The productivity would be highest (8 percent) in the year investment was made and showed a declining trend; reaching a minimum of 1 percent in the sixth year.

* Marginal value product (MVP) of investment in O&M spending is Rs 19 in six years. The present value of MVP was estimated to be Rs 13 at 10 percent discount rate.

* The agricultural output was estimated to increase at an average annual rate of 8.39 percent in response to 6 percent annual increase in O&M spending in real terms and moderate growth in demand (3 percent annually).

* O&M investments yield substantial gains to producers and consumers as the output is increased and prices are depressed, respectively.

7. POLICY IMPLICATIONS

* Estimates of marginal benefits to past and prospective future O&M investments suggest the need to allocate more funds for O&M of the canal system.

* Since other components of the irrigation system such as small dams, public tubewells, and drainage facilities compete with the canal system to have a share in the total provincial irrigation O&M budget, it is important to determine the economics of O&M in these components to make rational budgetary allocation decisions.

* In addition to producers who are the direct beneficiaries of O&M services, consumers should also be taxed to generate part of the funds required for O&M activities.

* The price support programs, targeted to favor producers, would provide an opportunity to finance O&M through enhanced water charges. Higher water charges would help to bridge the income distribution gap between irrigated and non-irrigated farmers.

NOTE: Readers interested in a more detailed exposition of the topic are referred to the following studies.

1. Chaudhry, M. Aslam and Mubarik Ali., 1988. "Economics of Past and Prospective O&M Investments in the Canal Irrigation System in Pakistan's Punjab". Special Report Series No.10, Pakistan Economic Analysis Network Project, Islamabad.

2. Chaudhry, M. Aslam., 1988. "Rationalization of Irrigation Water Charges in Pakistan: Answers to Some Policy Questions". Special Report Series No.9, Pakistan Economic Analysis Network Project, Islamabad.

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